

## CLAIMS

1. A method of reconstructing an image, the method comprising:
  - receiving a superposition of phase-weighted spin echoes, the superposition being representative of a two-dimensional spin density that encodes the image;
  - recovering a partial spin density from the superposition of spin echoes, the partial spin density being a PERL transform of the two-dimensional spin density; and
  - recovering the two-dimensional spin density from the partial spin density by analytically evaluating an inverse PERL transform of the partial spin density.
2. The method of claim 1, wherein recovering the two-dimensional spin density comprises evaluating an integral of the partial spin density weighted by a bandwidth-limited eigenfunction orthogonal to the Bessel functions.
3. The method of claim 2, further comprising selecting the bandwidth-limited eigenfunction to include an integral of a Chebycheff polynomial.
4. The method of claim 2, further comprising selecting the bandwidth-limited eigenfunction to include a term represented by

$$M_m(ky) \equiv \frac{(-i)^m}{k\pi} \int_{-k}^k \cos\left(m \cos^{-1}\left(\frac{-\omega}{k}\right)\right) e^{-i\omega y} d\omega$$

where  $\omega$  is a spatial angular frequency and  $k$  is a wave number.

5. A method of calibrating a PERL coil, the method comprising:

generating a Fourier encoded image having a phase encode gradient field that varies along a periodic direction of the PERL coil;

causing the PERL coil to generate a PERL field during a read-out time;

generating a Fourier reconstructed image, the reconstructed image having features indicative of a misalignment between the PERL field and the phase encode gradient field; and

adjusting an effective position of the PERL coil to reduce the mismatch.

6. The method of claim 5, wherein adjusting an effective position comprises physically moving the PERL coil.
7. The method of claim 5, wherein adjusting an effective position comprises varying current passing through the PERL coil.
8. A method of calibrating a PERL coil, the method comprising: /

generating a Fourier encoded image having a phase encode gradient field that varies along a linear direction of the PERL coil;

causing the PERL coil to generate a PERL field during a read-out time;

generating a Fourier reconstructed image, the reconstructed image having features indicative of a mismatch between a magnitude of the PERL field and a magnitude of the phase encode gradient field; and

adjusting a current flowing on the PERL coil to reduce the mismatch.

9. An apparatus for generating a PERL field, the apparatus comprising:
- a substrate having first and second layers;
  - a first trace pair having
    - a first conductive trace defining a first waveform on the first layer, the first waveform being spatially periodic in a periodic direction;
    - a second conductive trace defining a second waveform that is the mirror image of the first waveform;
    - the first and second conductive traces being electrically connected to each other;
  - a second trace pair electrically connected to the first trace pair, the second trace pair having
    - a third conductive trace defining a third waveform on the second layer, the third waveform being identical to the first waveform, the third conductive trace extending further than the first conductive trace along a linear direction orthogonal to the periodic direction;
    - a fourth conductive trace defining a fourth waveform on the second layer, the fourth waveform being identical to the second waveform, the fourth conductive trace extending further than the third conducting trace along the linear direction;

the third and fourth conductive trace being electrically connected to each other.

10. A system for generating a PERL field, the system comprising:

a first apparatus as recited in claim 9,

a second apparatus as recited in claim 9, the second apparatus being spatially offset from the first apparatus along the periodic direction.

11. An apparatus for generating a periodic component of a PERL field, the apparatus comprising:

a substrate having a first surface and a second surface opposed to the first surface;

a first conductive trace defining a first waveform on the first surface, the first waveform being spatially periodic in a periodic direction; and

a second conductive trace electrically connected to the first conductive trace, the second conductive trace defining a second waveform on the second surface, the second waveform being identical to the first waveform but spatially offset therefrom by a half of a spatial wavelength of the first waveform.